uBooNE code - Bug #24557

MEC dial in GENIE reweight

06/22/2020 05:22 PM - Tingjun Yang

Status:	Assigned		**Start date:**	06/22/2020
Priority:	Normal		**Due date:**	
Assignee:	Steven Gardiner		**% Done:**	40%
Category:			**Estimated time:**	0.00 hour
Target version:				

Description

In MCC9, the default MEC model is in between the empirical MEC model and the Nieves model and a dial in GENIE reweighting package was implemented to allow smooth change between Nieves and empirical MEC model shapes with no normalization change. However, the current dial introduces a big normalization change.
Action items

- Steven Gardiner will implement a fix and validate it by the end of next week.
- A new release will be cut and Steven will provide new fcl files to analyzers. This should be available in two weeks.
- Steven can provide a tarball for people to test before the fix is incorporated into an official release.
- If the above plan does not converge quickly, Steven will investigate alternatives, such as generating samples with the empirical MEC model and the Nieves model.

History

#1 - 06/23/2020 08:18 PM - Steven Gardiner

- % Done changed from 0 to 20

- Status changed from New to Assigned

- File Screen Shot 2020-06-23 at 1.09.23 PM.png added

- File mecRWValidWs10_Niev.png added

- File mecRWValidEv_10.png added

- File emp2DStandard_10.png added

- File emp2DRWNiev_10.png added
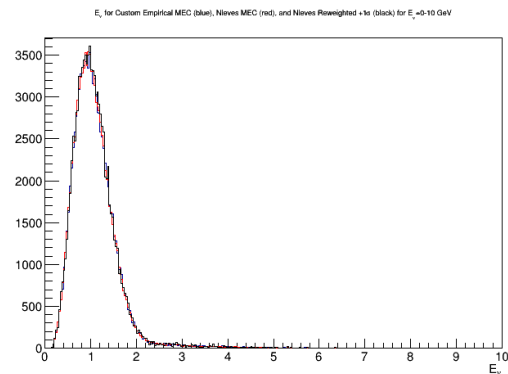
- File emp2DNiev_10.png added

An initial version of the fix has been implemented and appears to mostly behave as expected. The normalization of the neutrino energy distribution remains consistent before and after reweighting to XSecShape_CCMEC == 1 (Valencia --> Empirical). This was emphatically **not** the case in previous versions of the XSecShape_CCMEC weight calculator (see attached plot for T2K). The reweighted shape distribution in (Q^2, W) space looks reasonable.

Some discrepancy in the location of the W peak remains between events generated with Empirical MEC and the reweighted Valencia events. This is under study.

#2 - 06/26/2020 11:44 AM - Steven Gardiner

- % Done changed from 20 to 40

- File mecRWValidEvCustomEmp_10.png added

- File mecRWValidElCustomEmp_10.png added
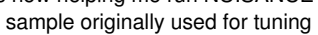
- File mecRWValidCthlCustomEmp_10.png added

Further tests of the fixed knob revealed the need to correct the generated Empirical MEC samples for the difference in the energy-dependent total cross section σ(Ev) between the Empirical and Nieves CCMEC models. This sort of model variation affects the kinematic distributions but is outside the scope of the XSecShape_CCMEC knob under study. After making this correction ("custom Empirical MEC"), Richie helped me check the reweighted events again. We find that the overall normalization continues to be preserved

E_ν for Custom Empirical MEC (blue), Nieves MEC (red), and Nieves Reweighted +1σ (black) for E_ν=0-10 GeV

and that the reweighted muon energy and angle distributions (which should be reshaped by this knob) are close to Empirical MEC "out of the box."

The discrepancy in W seems largely driven by an incorrect calculation stored in the GENIE event record. The Nieves model throws lepton kinematics before any information is known to the generator about the initial-state struck nucleon pair. Converting from muon energy and angle to W and Q^2 (the phase space in which the Empirical MEC model was implemented) requires knowledge of the initial nucleon pair momentum. Because this momentum is not set by the Nieves model when kinematics are sampled, W is calculated for a nucleon pair initially at rest. The value stored in the event record is thus not generally equal to the value seen by the weight calculator. Steven will continue to look into some of these details, but the level of agreement seen for the reweighted energy/angle of the outgoing lepton suggests that this is not a major concern. The erroneous W value is not used by any of the downstream GENIE infrastructure relevant for uboonecode. As long as the energy/angle distribution looks good, Geant4 will be provided with the correct lepton 4-momentum from GENIE, which is what we really care about.

Performance of the fixed knob seems reasonable so far. Executing the standard MCC9 fcl for GENIE systematics reweighting (run_eventweight_microboone_mar14.fcl) takes about 5 minutes to complete for a 50-event file. This seems roughly consistent with reports from analyzers before the MEC shape problem was discovered.

Richie is now helping me run NUISANCE with the patched knob. We will verify that (1) the normalization continues to be preserved when we reweight the T2K sample originally used for tuning !Screen Shot 2020-06-23 at 1.09.23 PM.png! and (2) that the fixed knob gives reasonable results when we run a first new fit to the T2K data. We hope to have the results early next week. If all goes well, we will quickly produce a tarball to allow analyzers to do some initial tests in uboonecode before a release is cut.

Files

emp2DRWNiev_10.png	16.7 KB	06/24/2020		Steven Gardiner
emp2DStandard_10.png	17.9 KB	06/24/2020		Steven Gardiner
emp2DNiev_10.png	25.2 KB	06/24/2020		Steven Gardiner
mecRWValidEv_10.png	11.8 KB	06/24/2020		Steven Gardiner
mecRWValidWs10_Niev.png	10.6 KB	06/24/2020		Steven Gardiner
Screen Shot 2020-06-23 at 1.09.23 PM.png	51.8 KB	06/24/2020		Steven Gardiner
mecRWValidCthlCustomEmp_10.png	13.3 KB	06/26/2020		Steven Gardiner
mecRWValidElCustomEmp_10.png	12.4 KB	06/26/2020		Steven Gardiner
mecRWValidEvCustomEmp_10.png	11.7 KB	06/26/2020		Steven Gardiner